APPENDIX A: COMPUTATION OF EXPECTED ELECTRIC FIELD STRENGTH

For a known power into a transmitting antenna and a given antenna efficiency, the expected signal strength in dBμV/m can be determined at a specified distance from the transmitter. Assuming the signal is radiating isotropically into a hemisphere (see Figure A-1), the power is evenly distributed over a surface equal to $2\pi r^2$ (where r is the distance from the transmitter in meters). The power density at the receiver expressed in watts/m^2 can be determined by

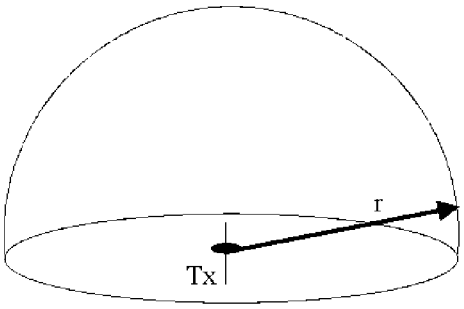

Figure A-1. Signal radiating isotropically into a hemisphere.

$$P_d = \frac{P_t e}{2\pi r^2}, \tag{A1}$$

where e is the efficiency of the transmitting antenna, and P_t is the input power in watts.

The electric field E in dBμV/m is determined by

$$E = 20 \log_{10}(1e6 \sqrt{P_d 377}), \tag{A2}$$

where 377 is the impedance of free space measured in ohms.

The efficiency and gain of the GWEN antenna at Appleton were determined by using the ITS antenna model, which is described by DeMinco [1] and references contained therein. The model is based on a set of algorithms that take into account the antenna tower, the radial ground plane, and the top loading of the antenna. The model predicts an antenna efficiency of approximately 50% and a directive gain for the ground wave (in the horizontal direction) of approximately 6 dB.

As an example, if the GWEN antenna were radiating isotropically with an efficiency e of 50% and signal power P_t into the antenna of 1000 W, the expected power density P_d at 10 km would be 7.96e-7 watts/m^2 (Equation A1). The expected electric field strength E at the same distance would be approximately 85 dBμV/m (Equation A2).

If the transmitting antenna is not radiating isotropically (as is usually the case), there is an additional gain that must be taken into consideration. For the example above, given a directive gain of 6 dB for the ground wave, the expected electric field strength *E* at 10 km is approximately 91 dBμV/m.

REFERENCE

[1] N. DeMinco, "Ground-wave analysis model for MF broadcast systems," NTIA Report 86-203, Sep. 1986.